

## Water quality of natural springs in Garhwal Himalayas

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Received on : 10-02-2008

Accepted on : 03-02-2009

### Abstract

Instead of having plenty of water in the Garhwal Himalayas in the form of Glaciers and snow fed rivers, a large population is facing the problem of easy availability of freshwater. Natural springs This paper deals with the study of natural water springs in Garhwal region. The parameters studied were alkalinity, acidity, DO, BOD, free CO<sub>2</sub>, nitrate, H<sub>2</sub>S, chlorides, hardness, inorganic phosphates, temperature, pH and coliform number. The study elucidates that the water quality of selected natural water springs is suitable for drinking purpose.

**Keywords:** - *Water quality, Natural springs, Garhwal, Physico-chemical, Biological*

### Introduction

Natural springs are the major source of potable water in most of villages in Garhwal Himalaya and are naturally emerging from earth. In hills, middle and upper dense vegetation of broad leaved trees viz. *Quercus leucotrichophora* (Banj Oak), *Quercus floribunda* (Moru Oak), *Rhododendron arboretum* (Buarns) etc., absorbs rain water during monsoon. This water is slowly released over the year by these broad leaved plants. Released water percolates in land and forms numerous channels which flows over the year and called as natural springs. Water is the most essential commodity for the entire living system on the earth (Shivashankara and Sharmila, 2004). Till now a very less amount of studies has been carried out on the springs of Garhwal region. Rare are the studies that have been conducted on the riverine ecology in the torrential reaches of the Indian uplands, to which the major rivers, the Ganga and Brahmaputra owe the existence (Nautiyal, 1986). Khanna and

Bhutiani (2004) worked on fish and their ecology of river Ganga at Gohri Ghat, Garhwal. The main objective of the present study, which is the first of its kind in this region, was to assess the current situation and state of spring in Garhwal region. The present study was conducted in order to obtain an overall picture of the prevailing ecological conditions and thus the water quality, in the spring fed Alkananda.

### Materials and Method

The physico-chemical and biological parameters of the water were recorded monthly at different stations followed APHA (1998) and Khanna and Bhutiani (2008). Total four sites were selected for the study as followings:

**Site-1 (Kothar dhara)** - Water emerges after passing through dense vegetation at this sampling site.

**Site-2 (Sweeth Bridge)** This spring lies adjacent to Government Medical College, emerges directly from earth and is surrounded by cemented pool which remains covered by slabs.

**Site-3 (Bhola Mahadev)** - This spring is situated at Srikot. Spring is surrounded by cemented pool.

**Site-4 (Barkot Spring)** - The sampling site lies 3.0 km away from Chauras campus in north. Water was flowing in cemented channels.

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## Results and Discussion

Table 1 represents results of various physico-chemical and biological parameters and is graphically presented in Fig. 1 and 2 at different sampling sites in natural springs.

The alkalinity of water samples was recorded as  $180.31 \pm 4.10$ ,  $178.12 \pm 7.43$ ,  $170.25 \pm 5.50$  and  $230.06 \pm 7.23$  at site 1, 2, 3 and 4, respectively, whereas the permissible limit as 200-600 mg/l. D.O. was recorded as  $2.30 \pm 0.66$ ,  $2.9 \pm 0.37$ ,  $1.3 \pm 0.28$  and  $6.4 \pm 0.36$  mg/l at site 1, 2, 3 and 4, respectively. The acceptable limit varies from 4-6 mg/l. BOD of water sample was recorded as  $0.83 \pm 0.16$ ,  $1.6 \pm 0.16$  and  $0.60 \pm 0.12$  and  $1.0 \pm 0.26$  mg/l at site 1, 2, 3 and 4, respectively. The acceptable limits of BOD are 2-3 mg/l, above this limit water is considered to be not fit for drinking purpose. Nitrate of water sample was recorded as  $0.58 \pm 0.08$ ,  $0.38 \pm 0.06$  and  $0.32$  mg/l at site 1, 2 and 4, respectively.  $H_2S$  was reported as

$5.90 \pm 0.40$ ,  $5.30 \pm 0.35$ ,  $5.30 \pm 1.08$  and  $3.76 \pm 0.63$  at site 1, 2, 3 and 4, respectively. Chlorides of water samples were recorded as  $34.17 \pm 2.11$ ,  $15.12 \pm 1.14$  and  $35.36 \pm 1.89$  and  $11.79 \pm 1.04$  mg/l at site 1, 2, 3 and 4, respectively. Free  $CO_2$  recorded as  $46.1 \pm 2.33$ ,  $34.7 \pm 2.13$  and  $72.6 \pm 3.83$  and  $37.31 \pm 2.21$  mg/l at site 1, 2, 3 and 4, respectively. Hardness of water samples were recorded as  $176 \pm 3.71$ ,  $141 \pm 10.12$ ,  $247 \pm 11.89$  and  $263 \pm 5.92$  mg/l at site 1, 2, 3 and 4. Inorganic phosphate in given water sample recorded as  $0.06 \pm 0.22$ ,  $0.06 \pm 0.01$  and  $0.09 \pm 0.01$  mg/l at site 1, 2 and 4, respectively. pH was recorded as  $6.90 \pm 0.65$ ,  $7.30 \pm 0.41$ ,  $7.26 \pm 0.12$  and  $7.29 \pm 0.14$  at site 1, 2, 3 and 4, respectively. Temperature was recorded as  $23.8 \pm 0.39$ ,  $23.7 \pm 0.86$ ,  $23.9 \pm 2.69$  and  $24.9 \pm 0.79$  at site 1, 2, 3 and 4, respectively. Coliform in given water samples was recorded as 0.50-22.0, 7.0-63.0, 0.5-10.0 and 32.00 to 450/100 ml at site 1, 2, 3 and 4, respectively. This test is indicator of fecal

**Table 1: The value of physico-chemical and biological parameters observed in natural springs of Garhwal region**

Sampling sites Parameters	Kothar-dhara	Sweeth Bridge	Bhola Mahadev	Barkot	Permissible limit (PL)
Alkalinity (mg/l)	$180.31 \pm 4.10$	$178.12 \pm 7.43$	$170.25 \pm 5.51$	$230.06 \pm 7.23$	200-600*
Acidity (mg/ L)	$81 \pm 1.84$	$63 \pm 1.79$	$121 \pm 3.74$	$76 \pm 2.75$	N.R.
D.O. (mg/ L)	$2.3 \pm 0.66$	$2.9 \pm 0.37$	$1.3 \pm 0.28$	$6.4 \pm 0.36$	4.0-6.0*
B.O.D. (mg/ L)	$0.83 \pm 0.16$	$1.6 \pm 0.16$	$0.6 \pm 0.12$	$1.0 \pm 0.26$	2.0-3.0*
Nitrate (mg/ L)	$0.58 \pm 0.08$	$0.38 \pm 0.06$	NT	$0.32 \pm 0.04$	45-100*
$H_2S$ (mg/ L)	$5.9 \pm 0.40$	$5.3 \pm 0.35$	$5.3 \pm 1.08$	$3.76 \pm 0.63$	N.R.
Chlorides (mg/l)	$34.17 \pm 2.11$	$15.12 \pm 1.14$	$35.36 \pm 1.89$	$11.79 \pm 1.04$	250-1000*
Free $CO_2$ (mg/ L)	$46.1 \pm 2.33$	$34.7 \pm 2.13$	$72.6 \pm 3.83$	$37.3 \pm 2.21$	N.R.
Hardness (mg/ L)	$176 \pm 3.71$	$141 \pm 10.12$	$247 \pm 11.89$	$263 \pm 5.92$	300-600*
Inorganic Phosphate (mg/ L)	$0.06 \pm 0.22$	$0.06 \pm 0.01$	NT	$0.09 \pm 0.01$	0.046-0.068*
Temperature (°C)	$23.8 \pm 0.39$	$23.7 \pm 0.86$	$23.9 \pm 2.69$	$24.9 \pm 0.79$	N.R.
pH	$6.90 \pm 0.65$	$7.30 \pm 0.41$	$7.26 \pm 0.12$	$7.29 \pm 0.14$	6.5-7.5*
Coliform no. (Per 100 ml.)	L=0.5 U=22	L=7.0 U=63	L=0.5 U=10.0	L=32.0 U=450	50-500*

\* Public Health Engineering Department, Govt. of West Bengal

NT=Not Traceable; L=Lower Limit; U=Upper Limit





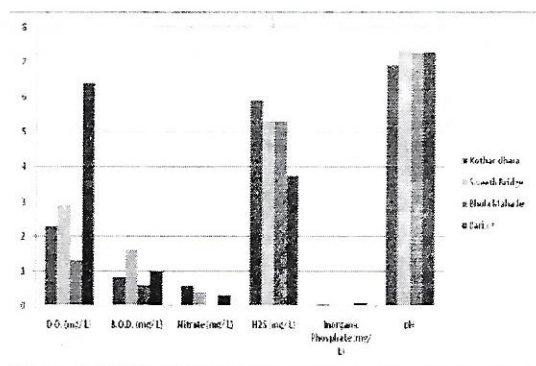


Fig. 1: The graphical representation of of physico-chemical and biological parameters observed in natural springs of Garhwal region

contamination. The permissible value of coliform in the sample is very much disputed. WHO recommends the coliform count 0/100 ml for drinking water while the Indian standards are very much flexible and permissible value of coliform is 50-500/100 ml.

Groundwater is rich in carbonic acid and dissolved oxygen usually possesses a high solubilizing potential towards soil or rocks that contain appreciable amount of mineral calcite, gypsum and dolomite and consequently hardness level may increased. That's why the values of conductivity, TDS and DO were observed beyond the limit of drinking purpose (Singh *et al.*, 2007). Negi *et al.*, (2008) have reported water temperature to range between 14.62 to 20.25 °C at Ganga River. It is a well established fact that the dissolved oxygen budget of a river is a direct indicator of its biological state, as was also suggested by Lamb (1985). The temperature may not be considered as most important factor in case of pure water due to the eurythermic nature of aquatic biota, but in polluted waters, the temperature has serious impact on dissolved oxygen and BOD (Palharya and Malviya, 1988). Phosphate-phosphorus is one of the most important limiting nutrients of primary concern to aquatic ecology (Datta *et al.*, 1988). The world

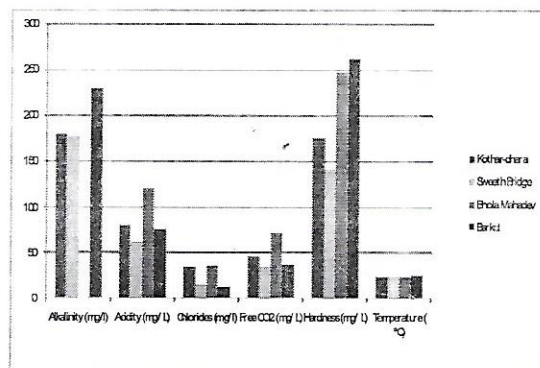


Fig. 2: The graphical representation of of physico-chemical and biological parameters observed in natural springs of Garhwal region

average for nitrate in unpolluted freshwaters as reported by Reid (1961) is 0.30 mg/l.

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